



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : LIN et al. Confirmation No: 2668
Appl. No. : 10/045,004
Filed : January 15, 2002
Title : LEAD-FREE SOLDER

TC/A.U. : 1742
Examiner : S. Ip

Docket No.: : LINK3019/REF
Customer No: : 23364

SUBMISSION OF AFFIDAVIT/DECLARATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is further in response to the Official Action of July 1, 2004, in connection with the above-identified application.

Applicants note in the advisory action that the Examiner states the Amendment filed June 22, 2004 does not place the application in condition for allowance because of reasons as set forth in the Final office action. It is further urged that Applicants' argument of unexpected result is noted. But, it is not in declaration form and the basis for unexpected result is unclear.

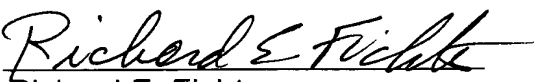
Therefore, in accordance with the Examiner's requirement, Applicants submit herewith an Affidavit showing the experiments and the unexpected results in support of the Amendment filed June 22, 2004. Accordingly, it is most respectfully requested that this Affidavit be entered as evidence.

Appl. No. 10/045,004
Response dated: September 23, 2004
Reply to OA of: March 23, 2004

In view of the above comments, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,

BACON & THOMAS, PLLC

By: 
Richard E. Fichter
Registration No. 26,382

625 Slaters Lane, 4th Fl.
Alexandria, Virginia 22314
Phone: (703) 683-0500
Facsimile: (703) 683-1080

REF:kdd
SubmissionofAffidavit.wpd

September 23, 2004



In re Patent Application of: Kwang-Lung LIN, et al.
Appl. No.: 10/045,004
Filed: January 15, 2002
Title: Lead-free solder

Affidavit

My name is, Kwang-Lung LIN, and I am a naturalized Taiwan citizen. I am one of the joint inventors of the invention entitled "Lead-free solder", for which an application for letters patent had been filed with the U.S. Patent Office, bearing filing number 10/045,004, filing date January 15, 2002. I hereby declare that the following experiments were conducted under my supervision and all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, as provided by law, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Experiments

Preparation of alloys: Sn-8.55% Zn-0.45Al and Sn-8.55% Zn-0.45% Al-0.5% Ag-0.5% Ga alloy Control Example

The preparation of alloys includes measuring 30 g of particles of pure metals with a purity of 99.99% according to Table A; mounting the particles in a quartz tube; sealing the tube with the flame of a mixture gas of oxygen and liquefied petroleum gas; withdrawing gas from the tube to form a vacuum in the tube, filling the tube with Ar gas, wherein the quartz tube has an inside diameter of 8 mm and an outside diameter of 10 mm; mounting the sealed quartz tube in a high temperature

furnace; heating the furnace to 800°C and maintaining the temperature for 3 hours, and cooling off the furnace, wherein the rate of temperature increase and decrease is 1°C/min; after the furnace having been cooled to 250°C, cooling the tube with water.

Table A

	Sn-8.55% Zn-0.45Al	Sn-8.55% Zn-0.45% Al-0.5% Ag-0.5% Ga
Sn	27.3 g	27.0 g
Zn	2.57 g	2.57 g
Al	0.13 g	0.13 g
Ag	0.0 g	0.15 g
Ga	0.0 g	0.15 g

Melting points of alloys

The melting point of the alloy was determined by differential scanning calorimeter (DSC) including heating the alloy in argon atmosphere from room temperature to 300°C while measuring the heat absorbance.

Tensile strength and elongation of the alloys

The tensile strength and elongation of the alloy were measured according to the ASTM Designation: E8-82 testing method, wherein the alloy ingot was processed into an elongation test bar by a desktop lathe. The dimensions of the test bar are 16 mm in gauge length and 4 mm in gauge diameter.

Microhardness of the alloys

The microhardness of the alloy was determined by using a Vickers microhardness tester with a load of 25 g.

Brittleness of the alloys

The alloy was processed into a film having a thickness of 0.5 mm by micrometer. The film was placed under atmosphere at room temperature for three weeks and was folded and unfolded five times to determine whether the film is brittle or not.

Results and conclusion

Table B shows the melting point, tensile strength, elongation and microhardness, and brittleness of the alloys.

Table B

	Sn-8.55% Zn-0.45Al	Sn-8.55% Zn-0.45% Al-0.5% Ag-0.5% Ga
Melting point	197.83° C	194.7° C
Tensile strength	75.7 MPa	93.9 MPa
Elongation	47%	42.2%
Microhardness	16.7 HV	25.2 HV
Brittleness	Broken after folding and unfolding 5 times	Intact after folding and unfolding 5 times

Data in Table b show that additional Ag and Ga results in a decrease in the melting point from 197.83° C of Sn-8.55% Zn-0.45Al to 194.7° C; about 25% increase of tensile strength; about 50% increase of

microhardness; and a slightly decrease of elongation from 47% of Sn-8.55% Zn-0.45Al to 42.2%. Further, the film of Sn-8.55% Zn-0.45% Al-0.5% Ag-0.5% Ga is tougher than Sn-8.55% Zn-0.45Al after 3-week aging.

Date: September 23, 2004

Kwang-Lung LIN
Kwang-Lung LIN
Professor

Department of Materials Science
and Engineering
National Cheng-Kung University
Tainan, Taiwan